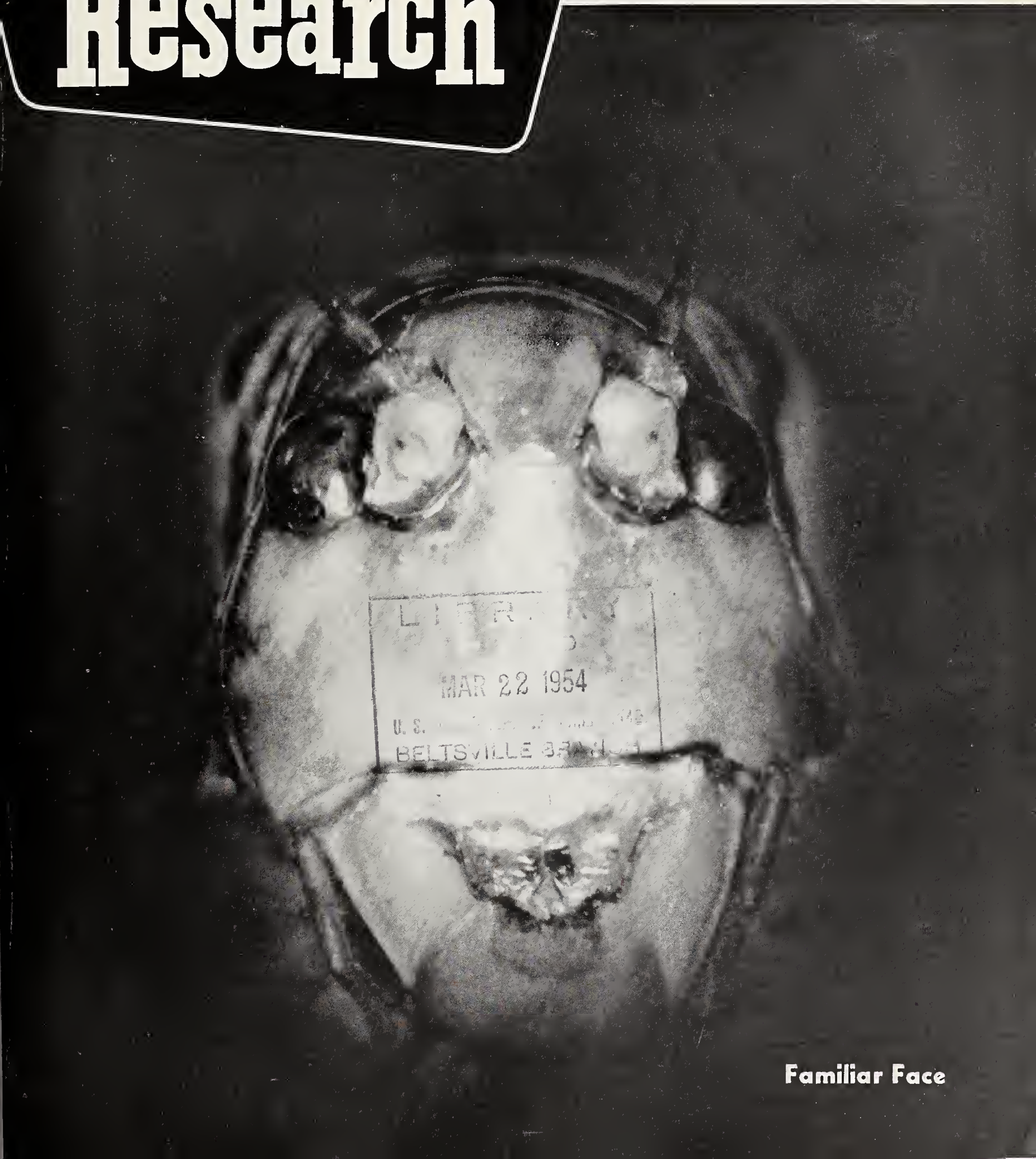
AGRICULTURAL

Research

MARCH 1954



Familiar Face

AGRICULTURAL Research

VOL. 2—MARCH 1954—NO. 9

JOSEPH F. SILBAUGH—MANAGING EDITOR

THIS IS 1 OF 10,000 faces familiar to professional entomologists, celebrating their 100th anniversary this year (story on p. 3). Meet one of the family *Acrididae*—Mr. Grasshopper.

Spreading the word

Remember when a farmer simply asked his seed dealer for a peck of "alfalfa" seed? Not Ranger or Buffalo—just alfalfa. And a bushel of "red clover" was good enough those days. Not Kenland or Midland.

Of course you remember. It hasn't been long ago. But had you thought how quickly, how drastically that situation has changed?

As a survey by seed dealers shows, today's farmer asks for superior new varieties by name. He accepts the new ones as fast as breeders release them. He usually wants more seed than he can get.

Just show today's farmer that a variety carries resistance to insects or disease . . . that it matures at the right time . . . that it can be handled by machine . . . that it produces high yields. He'll buy it.

Take the new sorgos Sart and Tracy. They were outstanding in 1952, when rainfall was fairly heavy—then stood up well under last year's drought. Now there isn't enough seed in the South to go around.

What brought on this change? Reliability of new varieties is the main thing. Today's farmer knows he can depend on our plant breeders. Another point is the cooperative effort (Agr. Res., Nov. 1953) to make more seed of new varieties available quicker and at reasonable prices.

But don't overlook the importance of telling the farmer about all this. Today, he knows of a new variety before it's on the market.

First news may come through State and USDA progress reports. Farm and trade magazines, newspapers, radio. and television tell the story. Extension workers and vocational teachers help keep the farmer informed. He can see the new material in tests at his State experiment station and in demonstration plantings in his own community. Seedsmen join in telling how to handle the new variety when it's ready to go.

This network of information sells new varieties. Furthermore, it's vital to all agriculture. The farmer—and those who make his supplies and handle his products—depends on the network to keep up.

And he must keep up. That means we must find better ways to do this job. Many improved farm practices are less spectacular and harder to sell than a new variety. Use may lag discovery by a generation.

All of us—scientist, salesman, agent, editor, and the rest—share a serious responsibility today to help spread the research word.

AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

Contents

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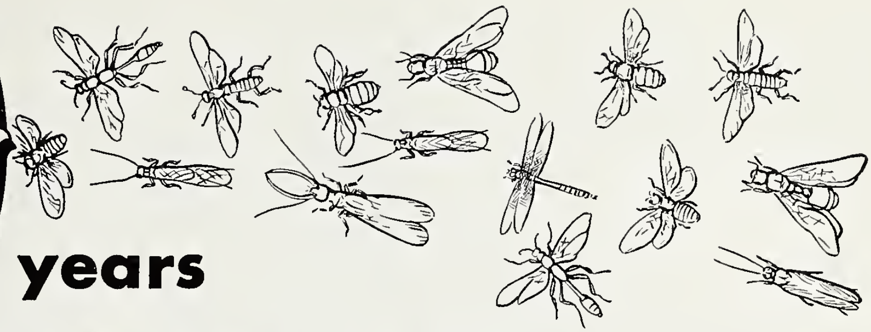
100 years of Professional Entomology



THIS YEAR, the profession of entomology is commemorating a century of service to the American public. It was in 1854 that Asa Fitch was appointed State entomologist in New York and Townend Glover became the first Federal entomologist, working for the agricultural unit of the Patent Office.

From this beginning, the profession has grown to 4,500 men and women in Federal and State agencies, schools, and business firms. Through research, education, and direct control and quarantine, these entomologists now carry on the fight against our insect enemies.

The very necessities of life are targets of 10,000 kinds of destructive insects in the United States. Our abundant food, good health, and high standard of living are due in part to the success of the profession's 100-year battle.

The $4 billion estimate of annual loss to insect pests is evidence of the job yet to be done.

Entomologists developed control methods that now prevent widespread devastation by such cereal-food pests as grasshoppers, hessian flies, chinch bugs, and army worms. Other anti-insect measures make possible the commercial production of fruits and vegetables. Meat animals gain faster, cows give more milk because of better methods of dealing with livestock pests.

Grasshopper control has saved nearly a billion dollars worth of food and livestock feed in the past 15 years. Cultural practices based on entomological research, along with resistant plant varieties, thwart the hessian fly and thus save from 60 to 100 million dollars worth of winter wheat each year. The codling moth, most serious pest of apples, once destroyed half or more of the Nation's crop. Damage now amounts to less than 5 percent. More than $100 million worth of extra meat, milk, and eggs reach the American market yearly because of better insect control.

At the turn of this century, entomologists led a great "Swat That Fly" campaign that brought public understanding of the fly as a disease carrier. Widespread use of screens, traps, sanitation, and insecticides stemming from this drive has had much to do with the 90 percent drop in United States typhoid cases since 1912.

A few years prior to the fly campaign, entomologists teamed with the medical profession against disease-carrying mosquitoes. The resulting control methods wiped out yellow fever in this country and have brought malaria incidence down to a practical zero.

Again, during World War II, entomologists played an important role in protecting our overseas fighting men. Development and use of DDT to control such disease carriers as mosquitoes, lice, fleas, and flies have saved an estimated 5 million lives and prevented more than 100 million illnesses since 1942.

Insects levy direct attack against our homes and possessions, our sources of lumber and fiber.

Use of modern measures against wool-feeding pests in the home could save much of their estimated $350 million annual damage to clothing, drapes, rugs, and upholstery.

In the forest, cooperative quarantine and control keep the tree-defoliating gypsy moth from slipping out of New England into hardwood timber of the Midwest and South. Recent efforts in the Pacific Northwest saved 3 million acres of Douglas fir from the spruce budworm.

Today, entomologists and other scientists are pressing a cooperative research program to halt the pink bollworm. This cotton pest moved in from Mexico in 1917. It was held in a small area by active control and quarantine till 1950, when it broke loose to infest most of Texas and large areas of Oklahoma and Louisiana.

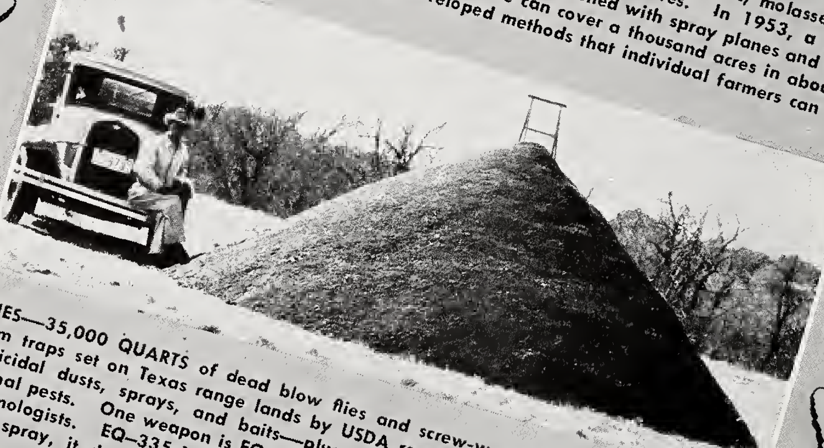
The counterattack against the pink bollworm involves research with new organic insecticides, cultural methods, parasitic insects and diseases, electronics, and atomic energy. This intensive campaign is setting a pattern for future insect-control investigations.

Today, professional enomologists look back on many accomplishments. They look ahead to sharing with other scientists the fulfillment through research of this Nation's future need for more food, feed, and fiber.→

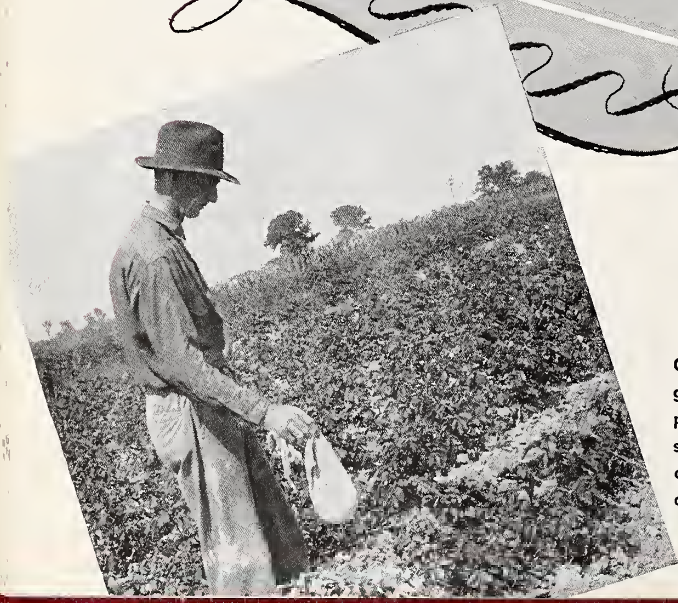
100 years of Professional Entomology

Insects and Our FOOD

POISONED GRASSHOPPER BAIT is mixed by Montana farmers, who drove their wagons many miles to this spot back in 1917. The mixture of bran, arsenic, molasses, and lemons was tediously spread over thousands of infested acres. In 1953, a grasshopper outbreak in Colorado and New Mexico was crushed with spray planes and truck-mounted mist blowers. A modern spray plane can cover a thousand acres in about 15 minutes. Entomologists have also developed methods that individual farmers can use.



FLIES—35,000 QUARTS of dead blow flies and screw-worm flies—make up this pile from traps set on Texas range lands by USDA researchers 25 years ago. Today, insecticidal dusts, sprays, and baits—plus sanitation—are used to control the many animal pests. One weapon is EQ–335, a smear containing lindane, developed by ARS entomologists. EQ–335 is used on livestock wounds to prevent screw-worm maggots; as a spray, it destroys sheep fleece worms that hatch from the eggs of blow flies.



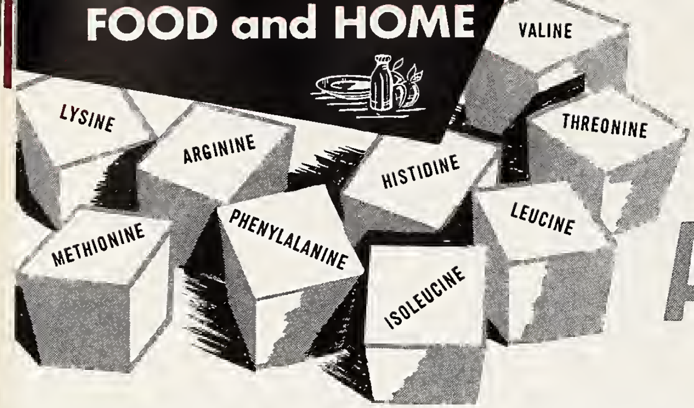
COLORADO POTATO BEETLE is battled by a Louisiana farmer using paris green—a method dating back to 1869. When Colorado settlers began growing potatoes, this formerly harmless insect took a liking to the crop. The pest swept eastward, wiping out potatoes over big areas. After paris green came other greatly improved arsenic insecticides and application equipment. DDT came in 1945 and has been a major factor in raising our potato yield average.

Insects and Our HEALTH

IRON BEDS, MOSQUITO NETS saved earlier generations from sleepless nights—and terrible diseases. Bed legs were often set in cans of kerosene to stymie crawling insects; iron discouraged other pests from taking up permanent residence in the frame; and net kept out deadly night fliers. The same control measures that allowed us to do away with iron beds and nets have also pushed out yellow fever and practically eradicated malaria. Since World War II, sanitation, screening, and use of organic insecticides and repellents have raised the world health standard by helping control such pest-borne diseases as malaria, yellow fever, typhus, plague, typhoid, dysentery.

Insects and Our GOODS

THIS 1920 HOMEMAKER watches as an upholstered sofa thought to be infested with the larvae of clothes moths or carpet beetles is placed in an airtight rubberized bag and liquid fumigant is poured through the special valve. The effect was good but didn't last long. Such a method of controlling fabric-feeding pests probably wouldn't be accepted so complacently by the 1954 housewife, who's accustomed to wielding spray guns containing new insecticides. Today, a thorough spraying with DDT will destroy established pest infestation and protect against reinfestation for several months.



New look at AMINO ACID figures

SCIENTISTS who measure amino acids—the protein building blocks in our foods and feeds—have been troubled for years with mysterious variations in test results.

These variations were often passed off as faulty lab work. Many couldn't be explained at all. And it seems likely that some, unnoticed, led to questionable conclusions.

Accurate amino-acid figures are important to nutritionists analyzing diets, chemists studying food content, plant breeders trying to increase certain amino acids in a crop.

They'll be glad to hear that ARS nutrition researchers have discovered a simple way to avoid some of the confusing errors in amino-acid assays. That's an advance in itself. But these scientists hope to go even further and find out what's behind the errors—a development that could lead to new concepts in nutrition.

Let's look at the common test. Suppose we want to measure the lysine content of a sample of wheat. We grind the grain, then boil it in hydrochloric acid. This process, called hydrolysis, breaks the wheat protein down into amino acids.

Now we're ready to measure the lysine in this hydrolysate. Bacteria will help do the work. It seems that some of them, like animals, must have amino acids to live and grow. Among such bacteria are those that produce lactic acid.

So we make up a special diet. This contains all the nutrients the lactic-acid-making bacteria seem to need—carbohydrate, inorganic salts, vitamins, the other 19 amino acids—everything except lysine. Now a bit of this basal diet is poured into a tube along with some wheat hydrolysate and a drop of water containing the bacteria. How well the bacteria grow depends on how much lysine is in the wheat. Growth is measured by the lactic acid produced.

All we lack now is a yardstick of normal growth—a graphic device called a standard curve. We make it up by adding *known* graded amounts of pure lysine to some of the same basal diet in different tubes, noting how much lactic acid is produced at each level. This gives us a standard with which to compare the lactic-acid figure from the *unknown*—the wheat sample. Calculating the lysine content of the wheat is now a simple matter of arithmetic.

A team of researchers led by M. J. Horn had been using this method to measure the amino acids in foods. But Horn and associates A. E. Blum, C. E. F. Gersdorff, and H. W. Warren kept finding discrepancies. The same wheat, for example, might appear to be high in lysine in one test, low in another. The scientists finally decided there was no point in going on till they could find a way to get dependable results.

To understand what was happening, we must go back to the breakdown process—the hydrolysis. Most foods contain carbohydrates (sugars, starches, and the like). And the proteins in these foods usually contain the amino acid tryptophan. With carbohydrate and tryptophan both present, acid hydrolysis produces a dark substance known as humin. Horn's team found out that this was the source of most of their trouble.

Humin caused no difficulty at first because the hydrolysates were filtered through carbon (a throwback to an earlier type of test requiring a colorless solution) before the bacteria and basal diet were added. This takes out the humin. Then the scientists found that carbon also picks up the amino acid phenylalanine.

So they tried unfiltered hydrolysates. These worked for leucine, threonine, and phenylalanine (by chance, the three on which the presence of humin has little or no effect).

But trouble showed up when the researchers moved ahead with other amino acids in a variety of foods, raw and cooked. Some values were high, others low. At times it seemed that there might be something to one of these common suppositions:

1. That acid hydrolysis in the presence of certain carbohydrates destroys amino acids. Actually, of the essential amino acids, only tryptophan—the one involved in the formation of humin—is destroyed.

2. That cooking destroys some amino acids. We know now that ordinary cooking binds certain amino acids, making them unavailable to the digestive system, but they aren't destroyed (AGR. RES., Aug. 1953).

Conflicting results soon made it clear that neither theory stood up.

The answer, Horn and his coworkers found, is far more complex.

A break followed changes in the diet of the bacteria. The researchers had increased vitamin B_6. This extra B_6 changed the measuring stick for each amino acid. In the case of lysine, the standard curve was lower—that is, the bacteria grew less with a given amount of the amino acid in the presence of extra B_6.

Now, this shouldn't make any difference in the result as long as the same concentration of B_6 is used in the diet for testing the food sample as in the diet for making the standard curve. This proved true with purified casein, a protein that contains no carbohydrate. But wheat was a different story. The researchers got two different lysine values, depending on whether the diet was high or low in B_6. Something in the wheat hydrolysate was giving more growth per unit of lysine than when the standard curve for this amino acid was made.

With this hint, the researchers discovered that they could get rid of the stimulating factor—and thus make accurate tests—by a different method of filtering out the humin. (See pictures.) They also found a complex relationship between the humin and the B_6. Furthermore, this relationship varies with each amino acid and with the level of the amino acid.

With low levels of arginine, for example, bacterial growth is increased by humin when the concentration of B_6 is high. But growth is stimulated by humin at a high level of threonine and a low concentration of B_6. And humin affects growth on all levels of lysine with B_6 high or low.

In filtering out this stimulating factor in humin, the scientists also took care of another difficulty. This, surprisingly, was an apparent loss of amino acids in the hydrolysates when they stood for a time before the tests were completed. A fresh unfiltered hydrolysate of black-eyed peas, for example, showed 8.5 percent arginine. A month later, another assay on some of the same hydrolysate gave a zero value for arginine. The true arginine value—that is, with the humin filtered out promptly after hydrolysis—was 7.55 percent.

Since something in humin caused values to run high, the scientists thought at first that the loss of amino acid in storage might simply be due to weakening of this active material. They soon realized, however, that the losses go far beyond the stimulation credited to the humin.

Thus, the effect of the stimulator in humin is soon offset—and more—by the effect of a destroyer. We know, too, that the speed and amount of the loss varies with each amino acid, even with each food.

So false values in amino-acid tests may result from a complex interplay; factors in the humin, kind and concentration of amino acid, kind of food, level of vitamin B_6, and storage time. Each case is different.

Horn can't say whether the humin factors occur naturally in foods or form during acid hydrolysis. And little is known about the relation of the amino-acid-stimulating factor to the amino-acid-destroying factor. Active humins have been found in acid hydrolysates of wheat, oats, corn, barley, rye, rice, kidney beans, lima beans, navy beans, black-eyed peas, split peas, and lentils.

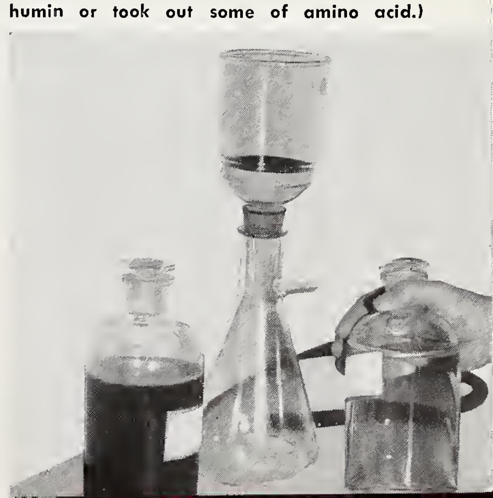
Knowing how to get dependable results will enable scientists in this field to move ahead with new confidence. And much previous work probably will need to be rechecked—it's easy to see what appeared to be an important difference in amino-acid content might have been nothing more than the effect of humin factors.

What are those factors? The answer may help us deal with some of the long-standing questions concerning metabolism of amino acids and interrelationships among proteins, fats, and carbohydrates.☆

HYDROLYSATE of barley, made by boiling ground grain 24 hours in hydrochloric acid, is neutralized to a moderately acid pH 4. (Dark pigment called humin also forms in most other methods of hydrolysis tried.)

HUMIN separates at pH 4 and is caught by porous glass filter. This wash water must be pH 4 too. (Humin, formed during hydrolysis with carbohydrate and the amino tryptophan present, fouls amino-acid assays.)

CLEAR hydrolysate, made to standard volume and nearly neutral pH 6.8, gives good results in bacterial tests. (Other methods of filtering tried either left in some of humin or took out some of amino acid.)



DOES A BREAK IN GROWTH HURT Beef Calves?

IT'S OFTEN SAID that you have to keep beef calves growing continuously if you want them to gain well. Some textbooks say the same thing.

The matter's important to cattlemen because the growth of calves is slowed down when they have to be carried for several months on sparse winter forage or drought-stricken range. The majority of our beef animals probably are raised under such a system.

But ARS animal physiologists now say the idea that you have to "keep 'em growing" isn't necessarily true.

In experiments at the Agricultural Research Center, Beltsville, Md., C. F. Winchester and associates interrupted the growth of beef calves for as long as 6 months with no apparent ill effects. Though their rations had been short on energy-giving carbohydrates, the calves still made good feeders if they had received enough protein, carotene, and minerals to maintain health and vigor.

The physiologists recognized, of course, that poor nutrition due to adverse range conditions usually involves a reduction in the quality as well as the quantity of feed. These scientists believed that any loss of ability to use feed efficiently after growth has been retarded may largely develop from lack of nutrients *other* than carbohydrates in the range forage.

To test this theory, the scientists used several sets of identical twin calves. Such twins, coming from the same egg and thus having common inherited characteristics, usually react in much the same way. This made it possible to draw conclusions in a relatively short period of intensive research covering the last 4 years.

One member of each set of twins was used as a control. This animal was fed a recognized liberal-allowance ration. The other twin of each pair became the experimental animal. Such twins were fed varying percentages of the full ration at varying ages and for varying periods.

The researchers discovered that the experimental calves—even those carried at a maintenance level—gained thriftily when they were later put on full feed. It didn't appear that the restricted ration and retarded growth had caused any loss of efficiency in feed utilization.

Calves carried on a ration containing only 50 percent of the liberal calorie allowance from the age of 6 months to 13 months neither gained nor lost weight appreciably during that period. When put on a liberal allowance, they gained just as well as the control animals—even better in some cases. The controls were slaughtered at slightly over 1,000 pounds at 16 to 22½ months of age. The experimental animals were slaughtered at the same weight at 20 to 22½ months.

Although the 50-percent ration had an energy content of only about maintenance level, the protein, carotene, and mineral content was adequate for rapid gains. So the calves, when put back on a full ration, were healthy and capable of resuming normal growth. This indicated clearly that their slowdown in growth resulted primarily from the low energy value of the ration.

At slaughtering time, the scientists found no appreciable difference in carcass grade or meat quality that could be charged to the interruption in growth. They found the cost of producing a pound of beef only slightly increased. They found, in fact, greater gains per unit of feed intake by the experimental animals during much of the period following limited feeding.

The scientists say that feeding for rapid, continuous gain in order to market beef at the earliest possible age is still the more profitable plan when feed prices are low enough. But they believe their work has proved that when feed prices are temporarily high, cattlemen may well carry young animals as long as 6 months on a maintenance ration that meets all the nutritional needs other than energy requirements for growth. Such a ration must contain *sufficient* protein, carotene, and minerals.

Winchester and his associates are now preparing to investigate how much "sufficient" actually is. The protein level of the ration will be investigated first. At present, there's little information available on the protein requirements of calves that are being fed just enough energy to maintain their body weight.☆

ON Full FEED

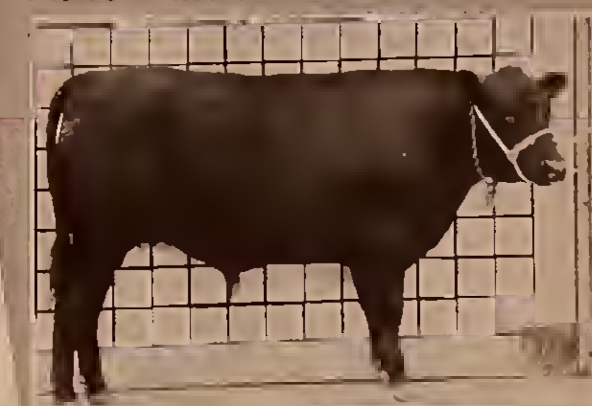
At 6 months

1. THIS IDENTICAL TWIN weighs 340 pounds as experiment begins. He stays on liberal ration, maintains growth.

At 12 months

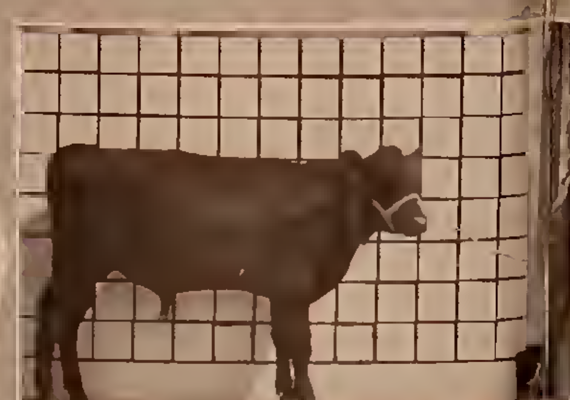
2. HEALTHY AND NORMAL in appearance, calf has made mean daily gain of about 1½ pounds. He weighs 618 pounds.

At 18½ months



3. READY FOR SLAUGHTER now, he tips 1,005 pounds. Animal has gained 665 pounds in 12⅘ months on full feed.

ON Half FEED



1. THIS IDENTICAL TWIN, on full feed till now, weighs 324 pounds as experiment begins. Now he goes on half feed.

2. HEALTHY BUT RETARDED, he has made a mean daily gain of less than 1/10 pound. He's up to just 340 pounds.

ON Full FEED

3. HE WEIGHS 832 POUNDS, after 6⅘ months on full feed. When slaughtered at 21 months, he scaled 1,008 pounds.

Antibiotics and Bacterial Diseases

INJECTED into peach tree, the antibiotic terramycin seemed effective in controlling bacterial spot. Researchers bored two ⅝-inch holes through trunk at right angles, midway between soil line and crotch (this made four openings, as shown in picture). Grafting wax sealed tubes in holes. Tree was flooded with terramycin in this way. Capsules of terramycin will be given trial.

Will eastern orchards ever again be able to grow high-quality Bartlett pears and Japanese plums? They may if antibiotics can stop two bacterial diseases that make commercial production of these two fruits possible only west of the Rockies.

Pathologist J. C. Dunegan says spraying experiments by ARS or State researchers in Delaware, Ohio, Missouri, California, and Oregon all point to the possibility that antibiotics may be effective for controlling fire blight and bacterial spot.

Dunegan emphasizes that copper sulfate controls fire blight better than anything else tried so far. He points out, however, that spraying pears five times with a solution of 38 grams (about 1⅓ ounces) of streptomycin to 100 gallons of water did almost as well.

Unlike copper sulfate, streptomycin didn't russet the fruit. This indicates that development of an economical streptomycin treatment could result in production of more pears for fresh marketing. Russeting now sends to processing much fruit that would otherwise sell fresh.

It was bacterial spot that doomed plums with Japanese blood in the humid East. As yet, there's no cure for this disease on Japanese plums, but small-scale tree-injection experiments on peaches suggest that terramycin may be of value. The disease attacks both plums and peaches.

Until now, a zinc sulfate-lime spray has retarded peach bacterial spot till harvest. But the disease stays in the trees and overwinters in the twigs. Unlike insect-borne fire blight, bacterial spot spreads from leaf to leaf by dew and from one tree to another by wind-driven rain.

Terramycin was applied as a spray to peach trees at four weekly intervals in orchards at Beltsville. The antibiotic didn't injure the peaches or defoliate the trees—but it didn't control bacterial spot, either. When injected into the trees, however, terramycin seemed to have some effect (see pictures). After 5 days, leaves of all the treated trees developed a yellowish cast that persisted for some 60 days. Defoliation of these trees was definitely retarded.

This demonstrates that terramycin, or some product from it, is readily translocated throughout peach trees. This season, Dunegan will encase terramycin in gelatin capsules and insert them in peach trees instead of injecting the solution directly.

Pathologists make no claims that antibiotics will solve the long-standing troubles of pear, plum, and peach growers. But some scientists do believe antibiotics show enough promise to warrant further research.☆

What's proper PASTURE FERTILIZATION today?

Proper fertilization is now recognized as one of the important steps in pasture improvement.

It hasn't always been so. Not long ago, farmers generally felt pasture fertilization didn't pay. Pastures, then made up largely of bluegrass and white clover, got fertilizer only when some was left over from applications on cultivated crops.

Then experiments showed pastures would respond well to lime and phosphate. Nitrogen and rotation grazing gave further improvement. "Summer slump" was lessened by the use of tall-growing, more productive forage species, along with rotation of pastures with cultivated crops.

What constitutes proper fertilization in today's good pastures?

There's a contrast with earlier experience and recommendations. Studies by ARS scientists at Beltsville, Md., as well as by State experiment station workers in the East, have shown potash often is more effective than phosphate in fertilizing high-yielding pastures. The experiments seem to indicate a heavy requirement for potash on many eastern soils.

So today's pasture fertilization recommendations, which once stressed superphosphate only, lean heavily toward use of phosphate and potash on a 1–2 basis, such as 0–10–20. Some States suggest a 1–3 basis.

Potash does have some tendency to leach away. Moreover, plants are piggish about using this element—so long as it's abundant, they'll absorb more than they need for good nutrition. Some of the applied potash is rendered unavailable by reactions taking place in the soil.

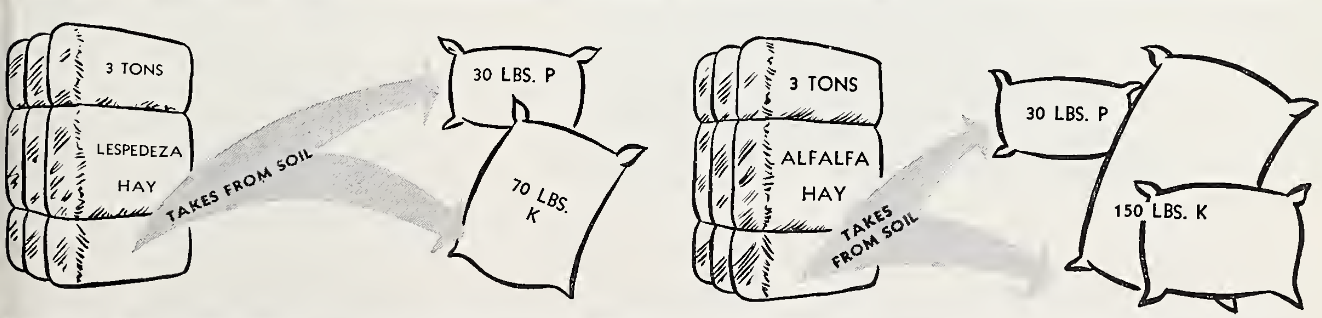
One way to use potash more efficiently would be to make limited applications oftener perhaps two or three times a year. The added cost of treatment raises a question of economics, which researchers are studying.

One of the big problems today is to discover the proper balance of nutrients, the individual requirements of various plants for the different elements, and the ability of the soil to supply them. Many soils, for example, give little or no response to potash but are highly responsive to phosphate. (See pictographs.)

Pastures of high-yielding mixtures have responded profitably to high fertilizer applications in tests by the USDA and many experiment stations, and confirmed in farming experience over a wide area. Among such mixtures are orchardgrass-Ladino clover, bromegrass-alfalfa, and Coastal Bermuda grass with clover.

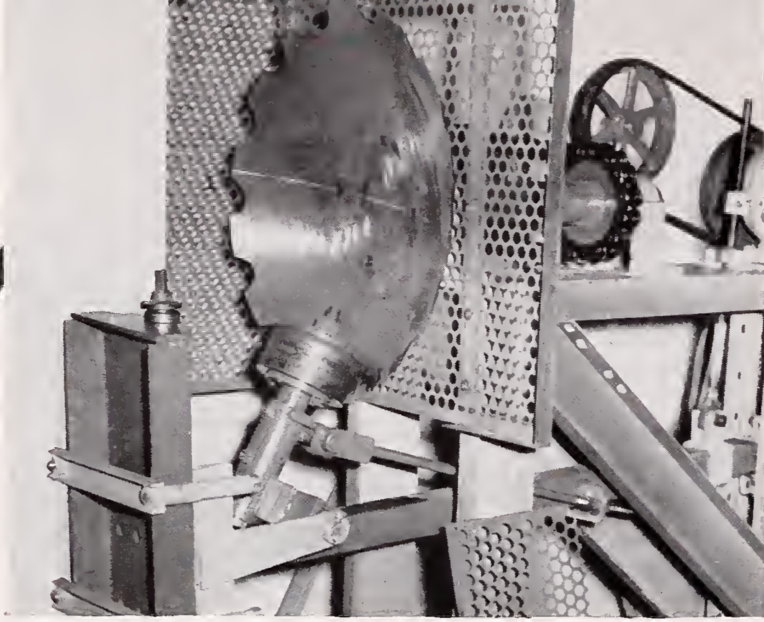
Research indicates need for further studies of the requirements of various grasses and legumes, and of the areas where they are grown.☆

In this same fertilizer-balance study he bromegrass-alfalfa produced more than 3 tons of good hay per acre when it got 4 tons of lime.



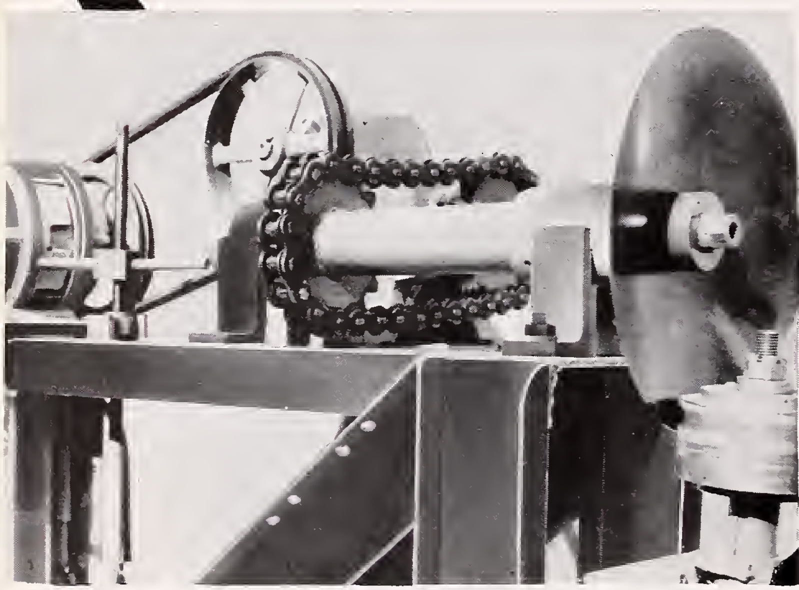
Experience shows considerable range in the requirements of different pasture grasses and legumes for the various plant-food elements.

Disc



WEAR-RESISTANCE tests were made on this machine, as well as under 500 to 800 hours of actual field use. Disks of cross-rolled carbon steels gave better performance than disks made from strip-rolled carbon steels. Cross-rolled steels were superior at all degrees of hardness (but less so as the hardness increased) . . . Steels relatively high in carbon and hardened to a range of 42–44 on the Rockwell C scale (a standard measure) gave the best service. Softer steels—both carbon and alloy—wore more rapidly. Harder steels were brittle and wore just as fast . . . Sharp disks wore much more rapidly than those with rolled edges until the sharp edges were rounded off; after that, the wear was about the same.

SHOCK-RESISTANCE was measured with this 200-pound hammer, which was dropped on disks from various heights, both parallel and at right angles to the axis. Cross-rolled carbon steels were much more shock-resistant than strip-rolled steels . . . Notched disks with notches cut at an angle without grinding stood considerably greater impact than disks with notches cut parallel to the disk axis and then sharpened by grinding.



FATIGUE-RESISTANCE was checked by running disks in contact with this roller at various angles and up to 2,175 pounds of pressure. Condition of the disks was checked every 100 revolutions, and tests continued till disks broke or became unserviceable. Cross-rolling carbon steels used in the disks definitely increased their fatigue resistance . . . Carbon and alloy steels were about equally resistant to fatigue when hardened to 42–44 on the Rockwell C scale.

Tests to improve

Implements

Few farm implements take a harder beating than such soil-working tools as disk plows and harrows.

Disks are in constant contact with the soil and are subject to hard wear by the abrasive action of soil, sand, and rocks.

At 5 miles an hour or more behind a modern tractor, the implement may take quite a shock if the operator fails to see a stump or boulder in time. Sometimes such obstacles are hidden. Even with an automatic trip, the impact may cause breakage.

Steels also get tired. Fatigue is especially important with disks because of the constant flexing they take.

These factors in the life of disk implements are largely beyond a farmer's control. Of course, he must be careful to avoid accidental breakage, as well as provide the usual maintenance to prevent damage from rust and corrosion. But resistance to wear, shock, and fatigue are largely built into the implement and may depend on design, construction, and material quality.

What kinds of steel make the best disks and what's the best treatment to impart wear resistance? How should disks be shaped, tempered, sharpened? Should they be plain or notched?

The answers have a direct bearing on farm production costs through machinery investments and expenditures for repairs and upkeep. They are also important to manufacturers who take pride in a reputation for building reliable machines and depend on the good will of their farmer-customers for continuing sales.

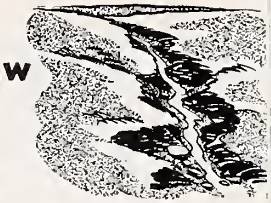
Research by ARS engineers at the United States Tillage Machinery Laboratory, Auburn, Ala., in cooperation with the farm-equipment industry, is helping answer some of these questions. Tests are carried on under both laboratory and field conditions.

Manufacturers furnished test disks made to various specifications. Carbon-steel disks included types from both strip-rolled metal (billets rolled continuously lengthwise to disk thickness) and cross-rolled metal (billets rolled lengthwise to 3 inches thick, then cut in short lengths and rolled crosswise). Strip rolling tends to set up cleavage lines in the steel.

Tests were run on disks made of both carbon and alloy steels tempered to various degrees of hardness.

Findings are summarized in the picture legends. Shock-test results suggest better performance from alloy steels under severe conditions. But use of improved carbon steels and proper heat-treatment hardening reduces the need for alloy steels in plow and harrow disks under 28 inches in diameter.☆

Wheat straw vs. soil conditioner



Wheat straw is more effective than a synthetic soil conditioner in preventing soil erosion and water runoff, according to preliminary results of tests in Nebraska. The chemical, however, shows promise of greater lasting quality.

HPAN (sodium salt of hydrolyzed polyacrylonitrile) is being used in the tests, which are cooperative between ARS and the Nebraska experiment station. Various trade formulations of this conditioner are available (AGR. RES., Feb. 1954).

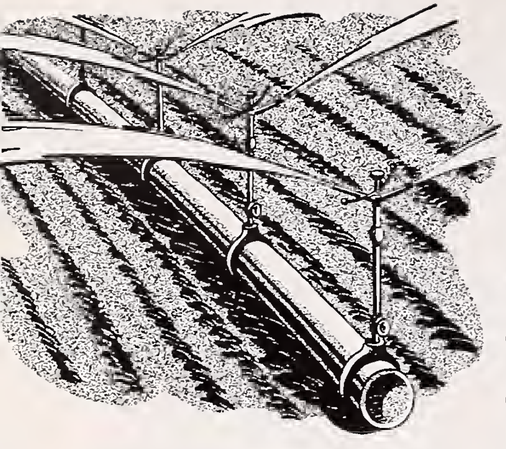
F. L. Duly established plots on an 8.5 percent slope of Sharpsburg silty clay loam. The surface was very dry when the treatments were applied. Plots were hoed frequently to keep down weeds. Results cover 17 months during two seasons.

At 1,000 pounds per acre, conditioner reduced erosion 44 percent as compared with untreated soils. Applications of 2,000 and 4,000 pounds reduced erosion 86 and 90 percent respectively.

Water runoff was reduced only 14 percent on the plot receiving 1,000 pounds of soil conditioner per acre. Treatments of 2,000 and 4,000 pounds of conditioner cut runoff 41 and 51 percent respectively.

A plot mulched with 2½ tons of straw per acre lost far less soil and water than any other plot in the test. Erosion was reduced 98 percent, runoff 89 percent.

Results so far suggest that straw mulch must be renewed annually. The mulch had largely decomposed after 17 months and would be expected to lose most of its effectiveness. The soil-conditioner treatments are continuing fairly effective into the second year of the experiments.☆



Big returns from SUPPLEMENTAL

Supplemental irrigation can have an important bearing on production of many crops in such high-rainfall areas as the Southeast.

Irrigation of corn jumped production an average of 25 bushels an acre in cooperative studies carried on since 1946 by scientists of ARS and the Georgia experiment station.

Supplemental water more than doubled tomato yields in the Georgia experiments (on land fumigated for nematode control) the last 3 years. In 1952 tests, nonirrigated land produced 6,452 pounds of tomatoes per acre. Production from irrigated land averaged 18,915 pounds—a 193 percent increase.

Yields of pole beans grown on Georgia uplands increased anywhere from 62 percent to 858 percent during 6 years of irrigating trials.

Irrigation of seed cotton in the Georgia tests produced comparable results. In 1952, for example, irrigated plots averaged 2,534 pounds an acre. Seed cotton grown on nonirrigated land yielded 742 pounds.

Independent tests by various southern experiment stations are adding weight to the evidence of benefits from supplemental irrigation.

Research conducted at the South Carolina station over a 6-year period showed that irrigation of corn paid off in all but one year.

An 11-year study at the Alabama station showed that stand, yield, and quality of several spring, summer, and fall vegetables were increased by applications of organic material and supplemental water.

Five-year studies carried on by the Tennessee station showed substantial yield increases from irrigation of bush and pole limas, broccoli, cabbage, tomatoes, and turnip greens.

Cows on irrigated pastures in Tennessee returned 43 percent more milk—worth $61.30 an acre—than cows on nonirrigated pastures. At the USDA Dairy Field Station, Lewisberg, Tenn., irrigation during the dry summers of 1951 and 1952 gave even better results (AGR. RES., Dec. 1953).

Ceiling Plants can hold down farm

Crop plants can sometimes be so well adapted, so vigorous, so persistent—yet, so low in value as food, feed, or fiber—that they put a ceiling on the productivity of a farm. A crop of this kind, particularly if it's a grass, may turn out to be one of the farmer's greatest problems.

Such a crop is centipede grass, says G. W. Burton, ARS forage-crops geneticist on the cooperative southern grass-breeding project at the Georgia Coastal Plain Experiment Station, Tifton, Ga.

Introduced in south Georgia 20 years ago, centipede grass soon drove out all other species of grass in fields where it was planted. But it made such poor forage that cattle actually lost weight when run on it.

Efforts to eradicate a field of this grass, which came from southeast Asia, show it to be most troublesome. An experimental area at the Tifton station was plowed and planted to cultivated crops for several years. The centipede grass was wiped out in the pasture itself, except under the fence. The land was then planted to Coastal Bermuda grass, a desirable improved strain of high yield and feed quality (AGR. RES., Feb. 1954). After 3 years, however, the tough mat of poor-feed centipede was back—just as bad as ever.

Then the centipede grass was plowed under, with the loss of 2 months of spring and summer grazing. Coastal Bermuda has a quick comeback, but the centipede proved almost as persistent. Soon the pest grass was so thick and thrifty that the experiment was given up as no longer producing worthwhile information.

Members of the Tifton research staff report that seeds of all the common southern pasture grasses can lie in a cow's digestive tract (including her series of stomachs) for 10 days and still be viable. A number of farmers are said to have centipede grass on their land as a result of buying cows that had been feeding on this species at seed time.

It's fortunate, say the grass men at Tifton, that the initial acreage of centipede grass was small. On the other hand, it's not the only species that has a low pasture potential. In some areas of the North, Kentucky blue-

IRRIGATION

In the ARS-Georgia tests, experimental pasture irrigation for 4 years (1947–50) increased the summer grazing period an average of 92 days and boosted per-acre gains of half-grown heifers by 80 pounds over animals on nonirrigated grassland.

In trials at the Virginia and Florida stations, beef cattle grazing on irrigated grasslands gained favorably in comparison with cattle grazed on nonirrigated pastures.

These research results indicate a big place for irrigation in humid regions—for balancing moisture distribution throughout the growing season, and for improving plant-food utilization. Properly used, irrigation can lead to higher yields of better quality crops, as well as closer control on maturity dates.☆

productivity

grass is considered a ceiling grass, although not a pest in the ordinary sense. Long a satisfying maker of meat and milk, Kentucky bluegrass has a limited potential as compared to the taller-growing mixtures such as bromegrass-alfalfa and orchardgrass-Ladino clover.

Recent studies of the relative value of pasture plants point toward breaking low-production ceilings and opening the way to grassland yields once thought impossible. More suitable species and proper management, developed by research, are the principal means of improvement. On the basis of information now available, no farmer need take chances on a little-known crop that might turn out to be a low-ceiling plant.☆

DAIRY

5,000 pounds is NOT ENOUGH

Keeping every cow in the dairy herd on the profit side of the ledger is increasingly important to the dairyman these days.

J. F. Kendrick and his ARS dairy coworkers have analyzed the 1952 production records of nearly 950,000 dairy cows. The results show once more that the cow that produces only 5,000 pounds of milk annually is barely paying her board and keep. Since the average cow on United States farms produces only 5,328 pounds of milk and 209 pounds of butterfat, this means that a third to a half of the cows in our 24,000 dairy herds may be star boarders.

By contrast to the national average, the 1,166,297 cows on test in farmer-operated Dairy Herd Improvement Associations in 1952 produced an average of 9,192 pounds of milk and 366 pounds of butterfat.

Kendrick found that cows producing only 5,000 pounds of milk were consuming $146 worth of feed for a total return of $151 over feed cost. With the average production for all DHIA cows at 9,192 pounds in 1952, feed cost averaged $165 for these animals and returns to the owners averaged $234 over feed cost.

Net income continued to increase as the production level increased. The analysis showed that DHIA cows averaging 13,000 pounds of milk in 1952 consumed $260 worth of feed and paid their owners a return of $393 over feed cost. The 13,000-pound rate, incidentally, is a practicable goal for most dairy farmers.

The relative difference in these figures is fairly constant. Comparison brings out the fact that high-producing cows are profitable under any economic conditions—good or bad.

Back in the depression days of 1932, DHIA figures reveal, the cow producing only 5,000 pounds of milk consumed $50 worth of feed and brought her owner only $46 over feed cost. That year, however, DHIA cows had an average production of 7,858 pounds of milk. That was enough to pay for $60 worth of feed and return an additional $88 per head.

During the same year, cows that produced an average of 10,000 pounds of milk for DHIA members ate $67 worth of feed and earned $123 over feed cost. Cows in the 13,000-pound class took care of a $79 feed bill and returned $222 besides.

The relatively high production level of Dairy Herd Improvement Association cows is one of the outstanding results of the plan started nearly 50 years ago by a small group of Michigan dairymen who wanted to take the guesswork out of their business.

Today, the DHIA program is operating in every State and in Alaska, Hawaii, and Puerto Rico as well. It is being carried on by more than 2,100 associations controlled by dairymen themselves and conducting monthly tests on 1,226,000 cows representing nearly 41,000 herds.☆

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AGRISEARCH *Notes*

New burleys resist black shank

Relief for burley growers whose land is infected with black shank is promised by two new varieties.

They are Burley 11A and Burley 11B, released by ARS and the Tennessee experiment station. The Virginia station also cooperated in their development.

It's recommended that these two tobaccos be grown in rotation with other crops on land heavily infected with black shank. They are also resistant to root rot and showed resistance to fusarium wilt in one test.

Burleys 11A and 11B were extensively tested in 1953 on farms and stations in Kentucky, North Carolina, West Virginia, Ohio, Indiana, Tennessee, and Virginia. Information on seed sources for 1954 planting can be obtained from experiment stations in the burley area.☆

Raising cane with chlordane

Sugar-cane yields were boosted more than 12 percent by controlling soil insects and related pests with the insecticide chlordane, in cooperative tests by ARS and Louisiana experiment station entomologists.

Application of chlordane to sugar-cane seed pieces in the planting furrow raised production from 21.3 to 24.1 tons per acre. Tests to determine the carry-over effect of chlordane into the second year showed even greater increases—20 to 30 percent and more.

Field treatment with chlordane dust, applied at the rates of 2 and 4 pounds of actual insecticide per acre, cost about $4.50 an acre. The entomologists figured the average annual cash gain from increased yield the first year after treatment to be about $18 an acre during the 5 test years, 1948–52.☆

Hand-reared pigs free of rhinitis

ARS hog breeders have tried raising rhinitis-free pigs by hand, in research on the disease atrophic rhinitis (AGR. RES., May–June 1953). Here's how it was done at the Agricultural Research Center, Beltsville, Md.:

The pigs were caught at birth in sterile cloths, put immediately into special brooders, and given injections of sterile swine serum or porcine gamma globulin. A minimum amount of sow's colostrum, plus sow's-milk substitute diluted in swine serum rather than water, was fed by hand to each pig during its first 36 to 48 hours. Relatively early, at 3 weeks of age, milk feeding was stopped and the pigs were put on a pelleted diet.

Of 84 pigs raised by this method in the spring of 1953, 48 survived to 56 days of age. They averaged 39½ pounds. Their 121 litter mates were left with their mothers, and 99 of them survived to 56 days, averaging 37.2 pounds. But otoscope examinations indicated that 28 of these sow-reared pigs had rhinitis symptoms.

All the hand-reared pigs were diagnosed as rhinitis free and were still healthy at breeding age, early in December. Most deaths of these pigs were due to an acute, probably infectious, diarrhea. Under aseptic conditions, which were not maintained in these experiments, the high losses might have been avoided. Further studies need to be made, however, to increase survival percentages.☆

Team research on surplus fats

ARS and industry are teaming up for research on new uses for surplus animal fats and oils. The Association of American Soap and Glycerine Producers has set up a fellowship to expand work already under way at the Eastern Regional Research Laboratory, Philadelphia.

Success in pioneer work there led to establishment of the fellowship, which provides for a senior and a junior fellow for 1 year. They will push the search for fat-derived products usable in synthetic chemicals.☆

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